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Partie 4:
Transmission de données MPEG2-TS

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Digital interface –

Part 4:
MPEG2-TS data transmission

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CONSUMER AUDIO/VIDEO EQUIPMENT – DIGITAL INTERFACE –

Part 4: MPEG2-TS data transmission

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61883-4 has been prepared by IEC subcommittee 100C: Audio, video and multimedia subsystems and equipment, of IEC technical committee 100: Audio video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100C/185/FDIS	100C/214/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

IEC 61883 consists of the following parts under the general title: Consumer audio/video equipment – Digital interface:

- Part 1, – General
- Part 2, – SD-DVCR data transmission
- Part 3, – HD-DVCR data transmission
- Part 4, – MPEG2-TS data transmission
- Part 5, – SDL-DVCR data transmission

Annexes A and B are for information only.

CONSUMER AUDIO/VIDEO EQUIPMENT – DIGITAL INTERFACE –

Part 4: MPEG2-TS data transmission

1 Scope

This part of IEC 61883 describes the packetization and the transmission timing for MPEG2 transport streams for the IEEE 1394 digital interface. It describes the specifications for the IEEE 1394 packet, the CIP header and the transmission timing for use with the transport stream as specified in prETS 300 468. Explanation is based on the transport stream as specified in DVB.

2 Normative reference

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61883. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61883 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 61883-1:1998, *Consumer audio/video equipment – Digital interface – Part 1: General*

ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

ISO/IEC 13818-2, *Information technology – Generic coding of moving pictures and associated audio information: Video*

ISO/IEC 13818-3, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*

ISO/IEC 13818-9, *Information technology – Generic coding of moving pictures and associated audio information – Part 9: Extension for real-time-interface for system decoders*

prETS 300 468, *Digital broadcasting systems for television, sound and data services – Specification for service information (SI) in digital video broadcasting (DVB) systems*

3 Definitions, symbols and abbreviations

For the purpose of this part of IEC 61883, the following abbreviations apply:

CIP	common isochronous packet
CTR	cycle time register
DVB	digital video broadcasting (in Europe)
SI	service information
ETS	european telecommunication standard
MPEG	motion picture expert group
RTI	real time interface
TS	transport stream
TSP	transport stream packet

4 Construction of 1394 packet

4.1 Structure of the MPEG2-TS data stream

The length of the source packet is 192 bytes (see figure 1). The source packet consists of one MPEG2-TSP with a length of 188 bytes and a source packet header of 4 bytes. The source packet header contains a time stamp.

MPEG2-TS packets shall comply with ISO/IEC 13818 series.

4.2 Packetization of source packet of the MPEG2-TS data stream

A source packet is split into 8 data blocks with a length of 6 quadlets. Zero or more data blocks are packed in an IEEE 1394 isochronous packet. A receiver of the isochronous packets shall collect the data blocks of one source packet and combine them in order to reconstruct the source packet before sending this source packet to the application. There are restrictions on the transmission of fractions (see 5.2).

Active transmitters shall send an isochronous packet in every cycle. If not enough data is available to transmit in the isochronous packet, then an empty packet shall be transmitted.

4.3 Time stamp

The time stamp in the source packet header is used by isochronous data receivers for reconstructing a correct timing of the TSPs at their output. The time stamp indicates the intended delivery time of the first bit/byte of the TSP from the receiver output to the transport stream target decoder. The time stamp represents the 25 bits of the IEEE 1394 CYCLE_TIME register (CTR) at the moment the first bit/byte of the TSP arrives from the application, plus some offset. The offset is equal to the constant overall delay of the TSP between the moment of arriving (of the first bit) and the moment the TSP (first bit) is delivered by the receiver to the application.

5 CIP header

5.1 Structure of CIP header

The structure of the CIP header (see figure 2) for the MPEG2-TS is compliant with the two quadlet CIP header format explained in 6.2.1 of IEC 61883-1. The static values of the CIP header components are as follows.

SID	.....	(depends on configuration)
DBS	00000110_2	(6 quadlets)
FN	11_2	(8 data blocks in one source packet)
QPC	000_2	(no padding)
SPH	1	(source packet header is present)
DBC	0 ... 255	(see 5.2)
FMT	100000_2	(Format type of MPEG2-TS)
FDF	.....	(see 5.3)

5.2 DBC values

The first data block of a source packet (data block containing the source packet header) corresponds to a DBC value from which the three LSBs are '000'.

An isochronous packet contains 0, 1, 2 or 4 data blocks or an integer number of source packets.

Where the isochronous packet contains:

- one data block, then the DBC value increments with 1;
- two data blocks, then the DBC value is a multiple of 2, the LSB is '0';
- four data blocks, then the DBC value is a multiple of 4, the two LSBs are '00'.

Where the isochronous packet contains ***n*** source packets (***n*** is an integer) then the DBC value is a multiple of 8. The three LSBs are '000'.

5.3 FDF area

The structure of the FDF area is shown in figure 3. The definitions of the fields are as follows:

- TSF (time shift flag) indicates a time shifted data stream:
  - 0 = the stream is not time shifted.
  - 1 = the stream is time shifted.
- Res: reserved for future extension and shall be zeros.

6 Transmission of isochronous packets

6.1 Steps in transmission

An MPEG2-TS consists of TSPs with a length 188 bytes. In figure 4, an example is given of a TS which consists of several programs. Very often only one or a few programs has to be transmitted. If a program selection is carried out, then only those TSPs from that particular TS are transmitted. In this situation, the occupied bandwidth on the 1394 interface can be reduced. Reduction of the bit rate is carried out in a smoothing buffer. As a result of the smoothing operation, the TSPs will be shifted in time.

The TSPs at the output of the smoothing buffer are transmitted over the interface. During transmission this interface will introduce some jitter on the arrival time of the TSPs in the receiver.

In the MPEG2-TS there are strong requirements on the timing of the TSPs. The jitter introduced by the smoothing buffer and the transmitter of the interface must be compensated. To do this, a time stamp is added to the TSP at the moment it arrives at the input of the smoothing buffer or, if smoothing is not applied, at the input of the digital interface. The receiver of the interface contains a receiver buffer. In this receiver buffer, the introduced jitter is compensated.

6.2 Late packets

The time stamp in the transmitted source packet header shall point to a value in future. If for some reason the delay in the transmitter is too long, resulting in a time stamp which points in the past (late packet), then this source packet is not transmitted.

A late packet occurs if the actual value of the CTR becomes equal to the value represented in the time stamp from the source packet header, before the isochronous packet(s) which contain the source packet (including CRC), has been transmitted.

In the case of transmission of one source packet/cycle, the interval needed to transmit the complete isochronous packet can be calculated (the clock frequency and the number of bits is known). If a late packet occurs, then an empty packet or the next valid packet should be sent and the late packet is discarded.

In the case of transmission of more than one source packet /cycle, then the same procedure is followed. It is allowed to discard all source packets from the isochronous packet if one source packet turns out to be a late packet.

In the case of transmission of fractions it is recommended to collect first a complete source packet in the transmitter. If a late packet occurs, then the complete source packet should be discarded.

If a late packet occurs when some data blocks of the source packet have already been transmitted (e.g. at a bus reset), then data blocks remaining in the transmitting buffer are removed.

7 Buffering in the receiver

Buffering in the receiver is needed to compensate jitter introduced by smoothing buffer and transmitter. It is expected that at the moment of arriving in the receiver, the source packets or fractions of source packets are stored in the receiving buffer with the bus clock frequency (S100, S200 or S400 mode). The MPEG2 TSPs are read out of the receiver buffer and sent to the application at the intended delivery time of the first bit(byte) of the TSP. The intended delivery time is represented by the time stamp in the source packet header. The clock frequency used for reading the bytes from the TSP may be high.

Buffering needed for compensating jitter from the transmitter only is given in table A.1 and buffering needed for compensating the jitter introduced by smoothing of the TS is given in table A.2.

For the transmission of an MPEG2-TS as specified in DVB, it is expected that the buffer size in the receiver is 3 264 bytes.

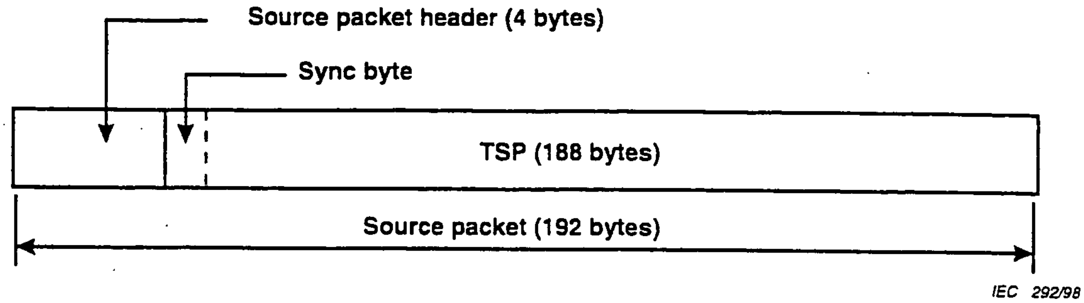


Figure 1a – Source packet

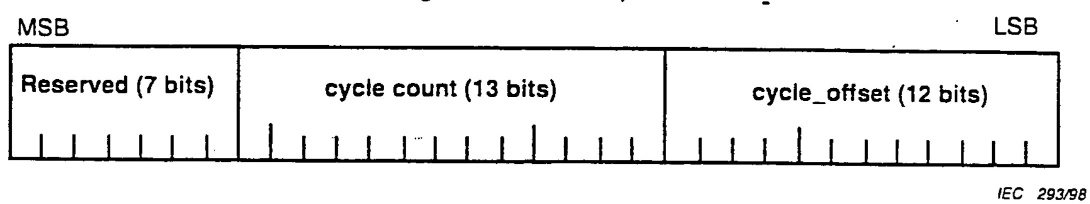
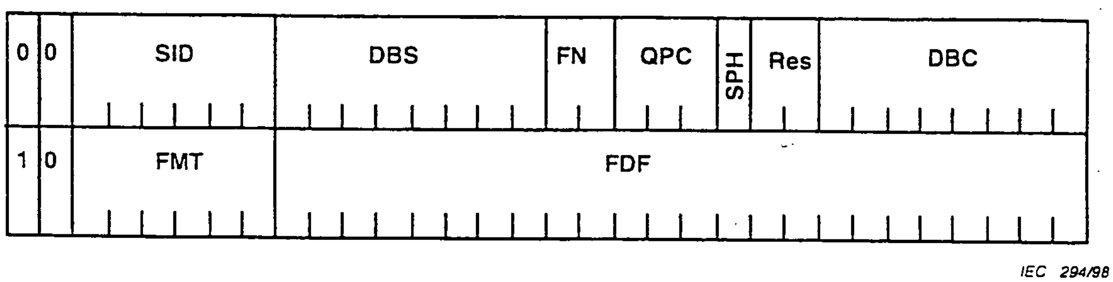


Figure 1b – Source packet header

Figure 1 – Structure of a source packet



SID	source node ID
DBS	data block size in quadlets
FN	fraction number
QPC	quadlet padding count
SPH	source packet header
Res	reserved
DBC	data block continuity counter
FMT	format ID
FDF	format depedent field

Figure 2 – CIP header for MPEG2-TS

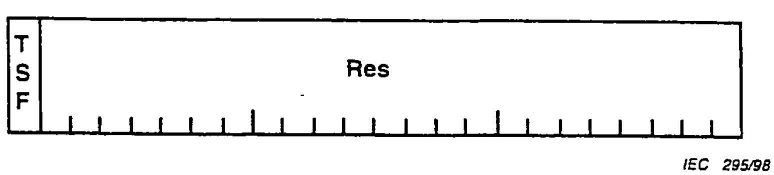
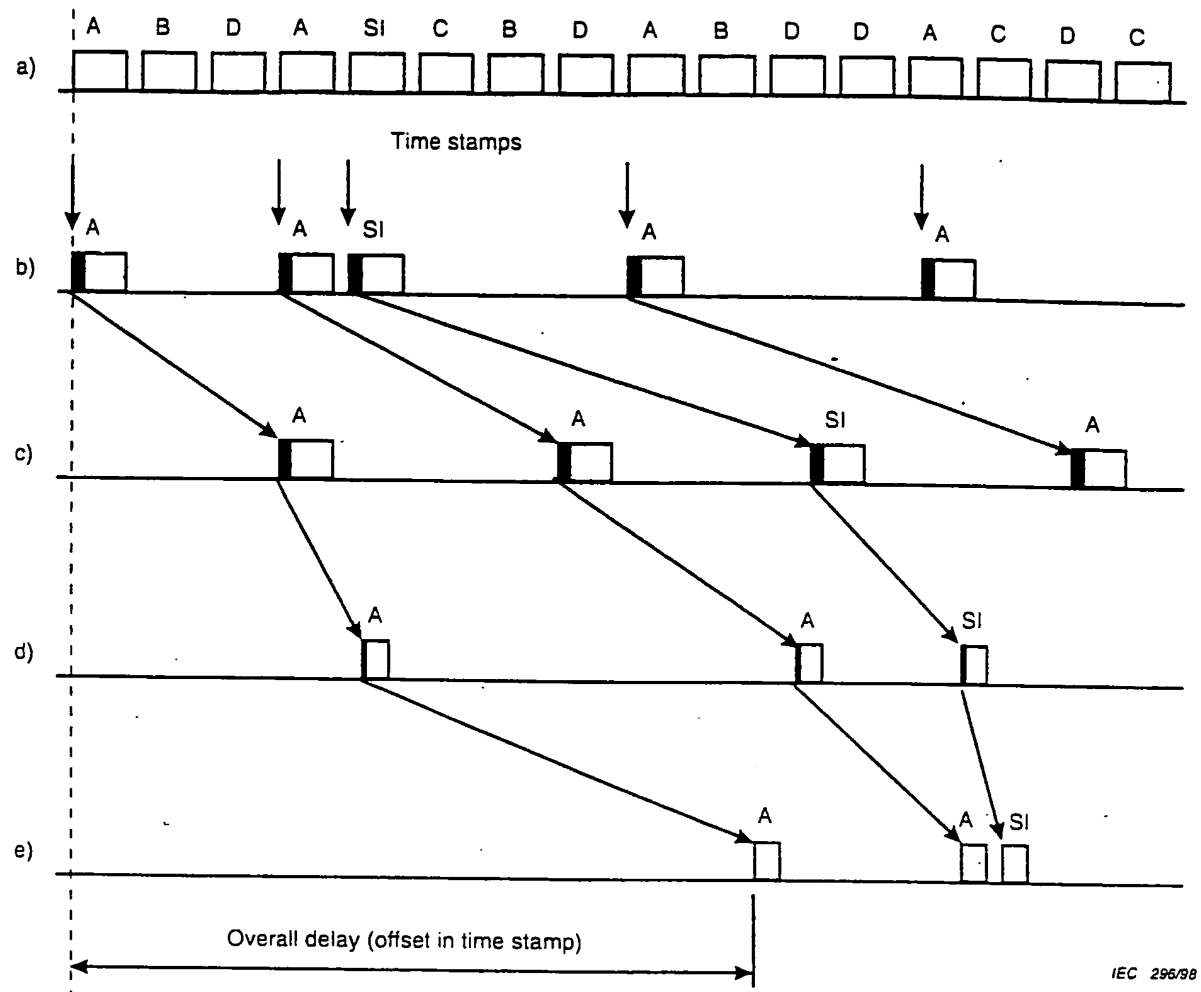


Figure 3 – Structure of FDF area



a) complete transport stream with multiplex of programs (A,B,C,D) and SI information
b) source packets of the selected program A with relevant SI information
c) source packets at the output of the smoothing buffer
d) source packets at the input of the 1394 receiver
e) reconstructed timing for the TS

b-c:	Delay in smoothing buffer
c-d:	Delay from transmitter
d-e:	Delay in receiver buffer

The clock frequency for transferring the bytes of a TSP may be different in every situation.

Figure 4 – Steps in the transmission of a transport stream

Annex A
(informative)
Buffering

A.1 Buffer needed to compensate jitter introduced by the transmitter

The TSP packet can be sent to the application by the receiver as soon as the CRC of the isochronous packet is carried out. The buffer size needed to compensate jitter introduced by the transmitter is given by the following relation:

buf_size = (R_bus) * (max_jitter) + (B_granularity)

where

R_bus is the allocated data rate on the interface;

Max_jitter is the maximum 1394_jitter (~ 311 µs) minus the minimum time needed to transmit one bus packet;

B_granularity is the size of one bus packet.

The necessary buffer size will be largest with high transmission rates (several TSPs per cycle) and high clock frequencies of the bus (400 Mbs).

In table A.1, the buffer size is given for some transmission rates.

A.2 Buffer needed to compensate jitter introduced by smoothing

The buffer needed to compensate jitter from the smoothing buffer is calculated with the following assumptions:

- the smoothing_buffer_descripter has a default value of 1 536 bytes;
- maximum jitter from the RTI is 50 µs (p-p);
- contribution of auxiliary data (SI) is restricted to one source packet.

In table A.2, the buffer size is given for some transmission rates.

A.3 Default buffer size in the receiver

The default value of the buffer size in the 1394 receiver is:

328 bytes (tentative)	for low bitrate applications;
3 264 bytes	for MPEG2-TS as specified in DVB;
32 kbytes (tentative)	where > 3264 bytes are needed.

With the default value of 3 264 bytes for MPEG2-TS transmission, a complete TS (without smoothing) with a bit rate of at least 60 Mbps can be transmitted or a single program with a bit rate of up to 24 Mbs (with smoothing).

Note that 17 source packets can be stored in 3 264 bytes.

Table A.1 – Minimum buffer size needed to compensate jitter originating from the 1394 transmitter

Transmission rate TSP/cycle	Transmission rate Mbps	Minimum buffer size bytes
1/8	1,504	82
1/4	3,008	165
1/2	6,016	328
1	12,032	654
2	24,064	1 296
3	36,096	1 927
4	48,128	2 547
5	60,160	3 154
NOTE 1 – The buffer size above does not include the size which depends on the reading out data rate. NOTE 2 – The clock frequency on the bus is 400 MHz.		

Table A.2 – Minimum buffer size needed to compensate jitter originating from the smoothing buffer (including RTI and AUX packet)

Transmission rate TSP/cycle	Transmission rate Mbps	Minimum buffer size bytes
1/8	1,504	1 733
1/4	3,008	1 743
1/2	6,016	1 762
1	12,032	1 799
2	24,064	1 874
3	36,096	1 950
4	48,128	2 025
5	60,160	2 100

Annex B
(informative)

Bibliography

The following documents contain additional information related to this standard:

[1] HD DIGITAL VCR CONFERENCE: December, 1995, *Specifications of consumer use digital VCRs using 6.3 mm magnetic tape – Part 7 and Part 8*

[2] DVB document A001, August 1994, *Implementation guidelines for the use of MPEG2 systems, Video and Audio in Satellite and Cable Broadcasting applications in Europe*
